COMPUTER CONTROLLED ENERGY MANAGEMENT SYSTEM

ROLLING RIVER SCHOOL DIVISION #39

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MANITOBA/CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

The availability of secure and affordable energy supplies is a subject of national concern. It is an accepted fact that our primary energy sources — oil and natural gas — are becoming less accessible and more costly. However, Canada is well-endowed with renewable and alternative resources that can provide a bridge into the future.

To this end, the governments of Manitoba and Canada entered into a Conservation and Renewable Energy Demonstration Agreement which was signed May 9, 1980 and terminated March 31, 1984. The Agreement was dedicated to the development and demonstration of conservation and renewable energy technologies. Equally cost-shared by the provincial and federal governments, the program had a total budget of $18-million.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies within Manitoba.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

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1.0 EXECUTIVE SUMMARY

A project to install a remote computer energy management system for four schools was jointly funded by Canada, Manitoba and the Rolling River School Division #39. The buildings were Erickson Collegiate, Rivers Collegiate Institute, Tanner's Crossing Elementary School and Minnedosa Collegiate Institute, all located in west central Manitoba.

The energy management system uses a central computer at divisional headquarters in Minnedosa to control the operation of the heating, ventilating and air-conditioning systems at each of the schools. Communication of data and control signals between the central control and remote processing units in the schools is accomplished via the telephone network.

Projected energy savings for the system were 35% on the $96,460 project for a 2.7 year simple payback period. Because of difficulties with data transmission from Erickson, this school was omitted from the project pending installation of a suitable alternative method of data transmission. However, the savings from the other three schools has averaged 40% overall, based on energy consumption.

The energy-related control techniques include optimized duty cycle and start/stop for unoccupied periods, as well as electrical energy demand control.

1.0 RÉSUMÉ ADMINISTRATIF

Les gouvernements canadien et manitobain et la Division scolaire n° 39 de Rolling River (Manitoba) ont financé conjointement un système informatique télécommandé de gestion énergétique pour quatre écoles du centre ouest de la province, à savoir : l'école secondaire d'Erickson, l'école secondaire de Rivers, l'école élémentaire de Tanners Crossing et l'école secondaire de Minnedosa.

Le terminal principal du système a été installé à Minnedosa. Il comprenait des satellites transmettant des données à un ordinateur central par l'intermédiaire de plusieurs lignes téléphoniques. Les coûts de ce projet totalisent 96 460 $ et sont récupérables sur une simple période de 2,7 ans. L'économie d'énergie que ce projet permettra de réaliser a été estimée à 35 %. Des difficultés étant survenues dans la transmission des données à l'école d'Erickson, on a dû éliminer cette école du projet en attendant de pouvoir remédier au problème. Malgré cela, les trois autres écoles ont économisé 29 % d'énergie en moyenne.

Les nouvelles techniques employées dans ce projet sont les suivantes : l'optimisation du cycle de fonctionnement et le démarrage/stoppage au cours des périodes creuses ainsi que le contrôle de la demande d'énergie électrique.

2.0 INTRODUCTION

Over the past ten years computer control of energy systems has become common. Most of the systems presently in use are based on one control computer per building. With the maturing of this technology, systems have been developed which use one centralized computer to control many buildings. By use of telecommunication networks, it is possible to control buildings that are separated by many miles. When management of more than a few buildings is required, these networks are more cost effective in terms of equipment and labour than the stand alone systems.

School divisions which have several buildings controlled by a centralized administration are particularly amenable to this technology, which offers a large potential for achieving savings in energy and maintenance costs.

Johnson Controls, one of several companies offering energy management systems, proposed a specific system for the Rolling River School Division #39 for the control of four buildings; Minnedosa Collegiate Institute (MCI), Rivers Collegiate Institute, Erickson Collegiate and Tanner's Crossing Elementary School. The location of these schools is shown in Figure 1. Johnson Controls was chosen for this project as it was the only company at the time that would guarantee an economical level of energy savings. Johnson Controls guaranteed a minimum savings of $35,700 per year of energy costs, which is equivalent to a 2.7 year payback for the $96,460 project.

A JC/85/10 Energy Management System was used at Rolling River S.D. #39. A Johnson Controls' brochure describing an expanded version, the JC/85/20, is provided for reference, in the Appendix.

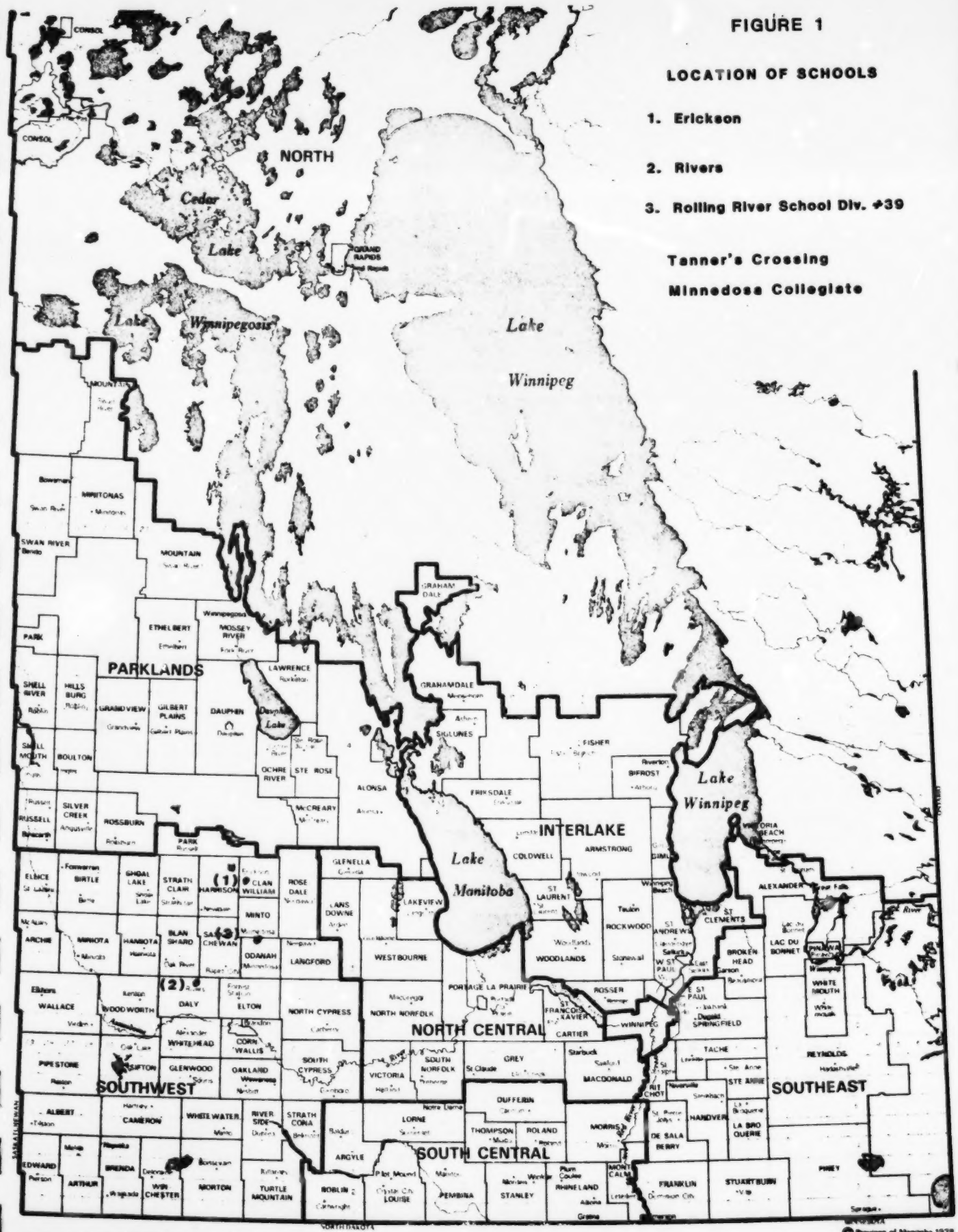
FIGURE 1
LOCATION OF SCHOOLS
1. Erickson
2. Rivers
3. Rolling River School Div. #39
Tanner's Crossing
Minnedosa Collegiate
NORTH
Cedar
Lake
Lake
Winnipegosis
Lake
Winnipeg
Lake
Winnipeg
Lake
Manitoba
PARKLANDS
INTERLAKE
NORTH CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
(1)
(2)
(3)
Cartography by: Surveys and Mapping Branch, Manitoba-1980
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3.0 CONTROL PHILOSOPHY

The overall energy management concept is to use a central processor (computer, CPU) located in divisional headquarters, to control the HVAC systems in the four remote school buildings.

Central control of building systems offers a number of logistical benefits to school divisions. The cost of this type of system can be less than the cost of achieving equivalent control with stand-alone controllers in each building. The increased awareness of systems operations allows central administration to improve budgeting for energy, equipment and labour requirements, and to improve maintenance scheduling. As a bonus these systems can be readily expanded for security control and loss prevention purposes.

3.1 The Control Process

The central processor makes control and energy optimization decisions based on internal programming (time scheduling, set and alarm points, control algorithm), in response to information received from the Field Processor Units (FPU) located in each school. Hard copy of pertinent CPU input and output is recorded on a printer linked to the CPU.

Each FPU receives and translates signals from sensors located throughout the school, and sends this information on to the CPU at divisional headquarters. The CPU tests this information against its program and decides whether a control action is required. When an action is required to be performed, control information

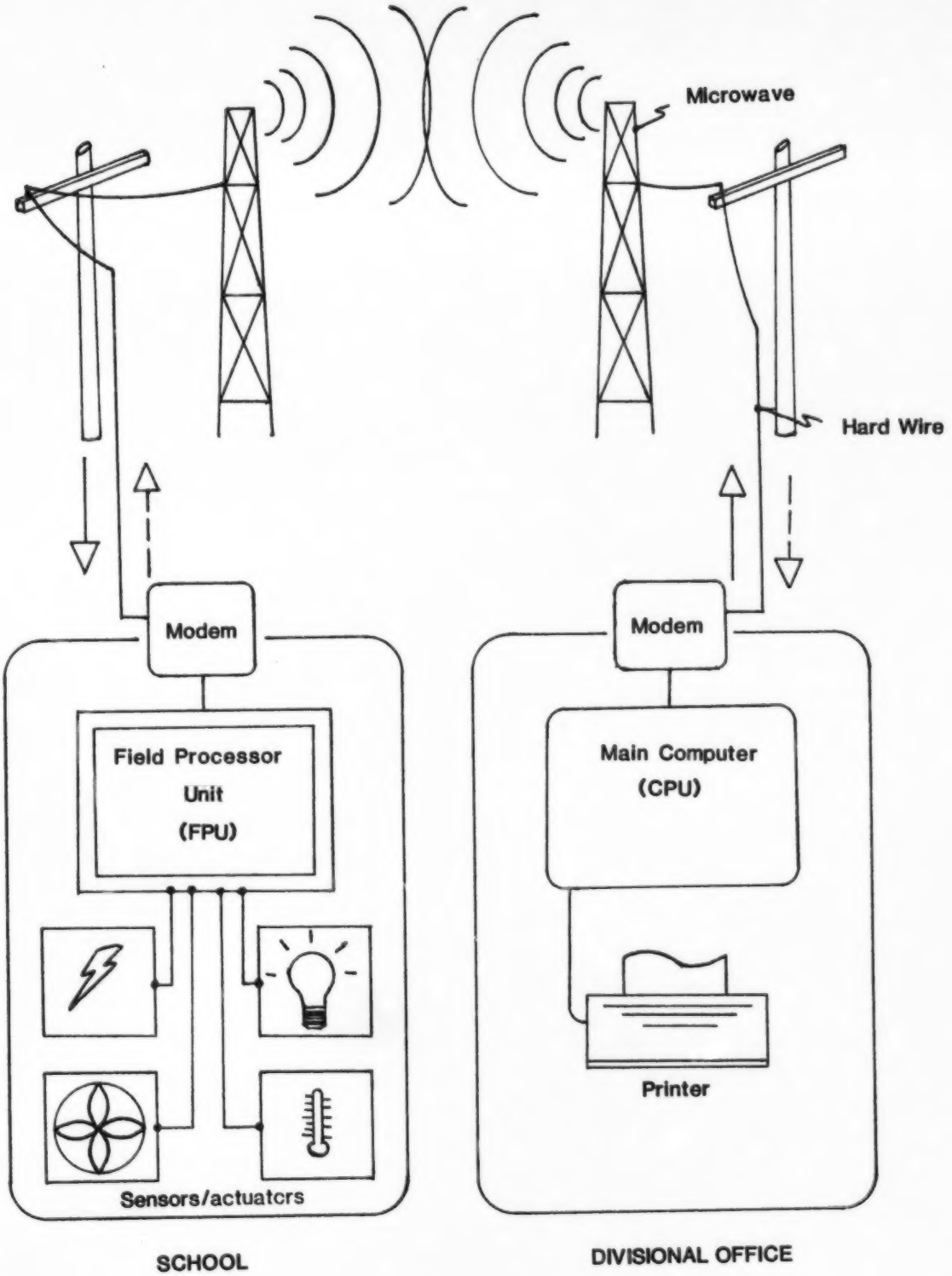


FIGURE 2 DATA ACQUISITION/CONTROL SIGNAL TRANSMISSION PATHWAY
ROLLING RIVER SCHOOL DIVISION

is sent back to the FPU in the appropriate school. From the FPU this information is passed on to the proper actuator module (eg motor switch, proportioning valve, etc.) which implements the required action via pneumatic and/or electric control mechanisms.

Communication between the CPU and FPUs is therefore two way. (The FPUs communicate only with the CPU, not with each other). At Rolling River School Division #39 communication between the units is accomplished via the use of modems (modulators/demodulators) on leased lines of the Manitoba Telephone System. The means of transmission through the telephone system differs for the various schools. The transmission pathway for Erickson and Rivers Collegiates consists of both hard wire line and microwave link, while the pathway for Minnedosa and Tanner's Crossing consists of only hard wire line.

The FPUs have some stand-alone capability to allow an unoptimized functionality of the school's HVAC system in the event of failure of the transmission link with the CPU (or failure of the CPU).

3.2 Control Functions

As an example of some of the controlled functions in the schools, the energy conservation techniques implemented at Tanner's Crossing are as follows:

Programmed Start/Stop (Duty Cycle)

This program matches equipment run time and comfort levels with the actual occupancy schedule.

Optimum Start/Stop

This program calculates the earliest stop time for each air handling system based on interior space and mass temperature, rate of decay and recovery inputs.

Night Set-Back

Space temperatures are maintained at the lowest feasible set point during unoccupied hours.

Temperature Reset

By referencing outside air temperature, such systems as perimeter radiation heating can be either shut down or adjusted when a cooling load is being added to the HVAC equipment. (Implemented at Tanner's Crossing Elementary School only).

Ventilation Optimization

a) introduction of outside air is limited to those times when the spaces affected are occupied;

b) exhaust of building air is also limited to occupied times so that infiltration is reduced.

Demand Limiting

Through monitoring of the incoming electrical energy, certain non-essential as well as HVAC-related loads may be shed to avoid portions of the demand-related charges. Typical examples would be parking plugs, domestic hot water heaters, or the final stages of electric heat.

The control system used was a Johnson Control JC/85/10 Energy Management System which is described in Appendix I. The estimated savings are shown in Table I.

TABLE I

BREAKDOWN OF PROJECTED ENERGY SAVINGS

(JOHNSON CONTROLS CALCULATIONS)

School	Total Savings Dollars	Percentage of Energy Savings Heating	Cooling	Elec. Com.	Demand
Technique					
Erickson	$ 8,211.00				
duty cycle		31	n.a.	Inc. in Heating	n.a.
unocc/occupied optimum start/stop		62	n.a.	Inc. in Heating	n.a.
Demand		n.a.	n.a.	n.a.	7
Tanner's Crossing	$18,248.00				
duty cycle		16.8	5.0	2.9	n.a.
unocc/occupied optimum start-stop		36	1	34.0	n.a.
Demand Lighting		n.a.	n.a.	n.a.	5.1
MCI	$ 4,828.00				
unocc/occupied optimum start/stop		90	n.a.	10	n.a.
Rivers	$ 4,322.00				
unocc/occupied optimum start/stop		90	n.a.	10	n.a.

4.0 SCHOOL DESCRIPTIONS

4.1 ERICKSON COLLEGIATE, ERICKSON

The school was built in two phases. The initial construction was completed in 1963 while the second phase occurred in 1972. The total school area is 26,829 sq.ft. (2,492 m^2) with an exterior perimeter of 824 feet (389 metres).

The school consists of a gymnasium with showers and change facilities, a multi-purpose area, two science labs, a resource centre, a student lounge, administration area (5 offices), staff lounge, 12 classrooms and miscellaneous room areas (storage, washrooms, mechanical rooms and corridors).

The building is a single level structure with crawl space under the original building only. The newer building is constructed with a concrete slab on grade.

The wall construction of the newer system is as follows:

4" face brick, air space, 1 1/2" of rigid insulation, vapour barrier and concrete block (R7.5 total).

Domestic hot water is provided by one 60-gallon hot water tank with 2 - 4500 W elements. There is no recirculation system. The electric service is rated at 120/208 volts, three phase, 4 wire, 1200 amperes. The service is split and power is monitored through two meters. Power costs are charged at the General Service Rate and there is load shedding to control the maximum electrical demand at any given time.

A section of the roof was retrofitted with 3 inches of polyurethane foam (R22 total) and the remainder is built-up roof with an insulation value of R8.

Classroom and hallway illumination is provided by fluorescent units.

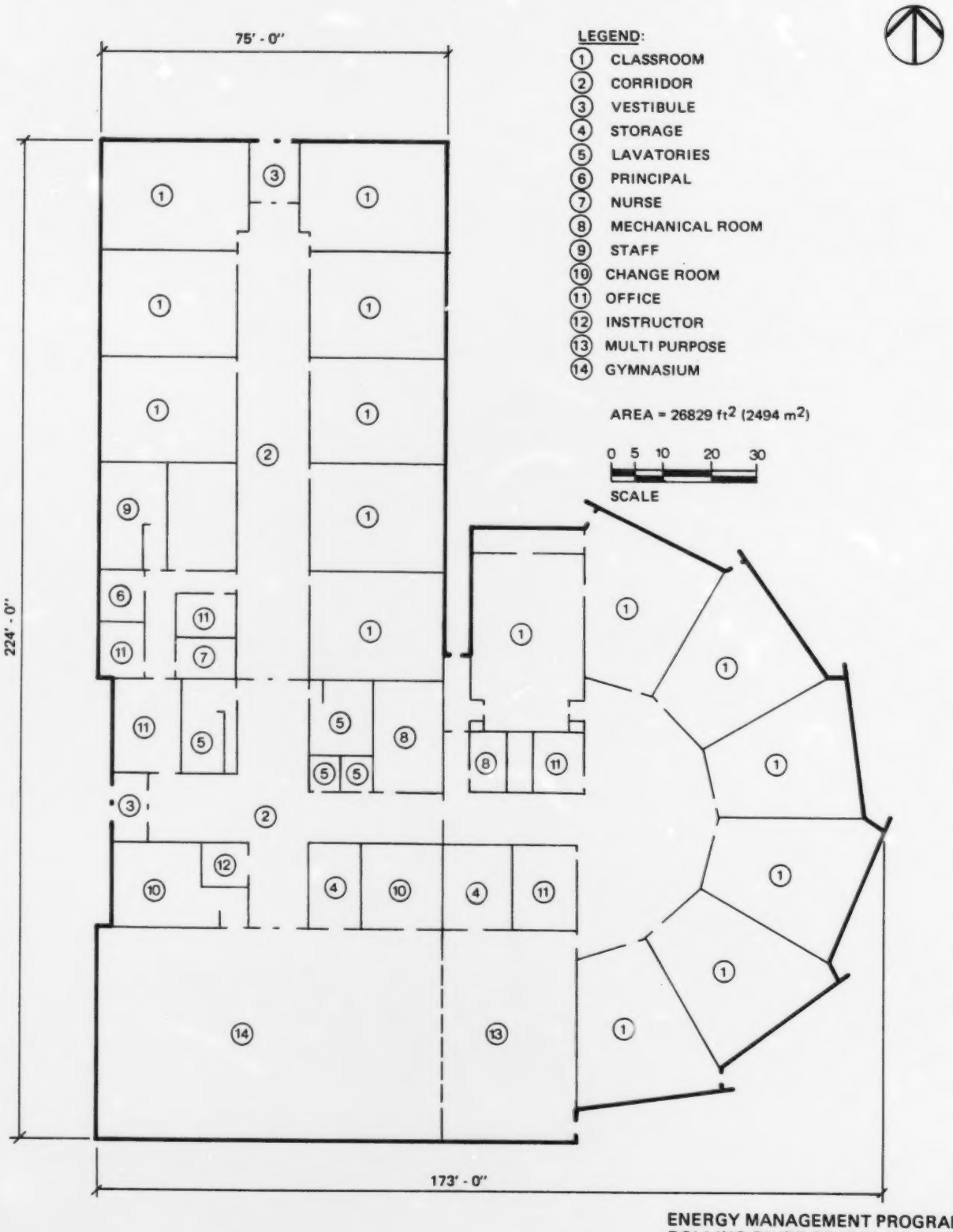
Because of difficulties with data transmission, the Erickson energy management control system was not on line during the report period.

4.1.1. Energy Consumption

Annual energy consumption (1981) was as follows:

Oil	769,992 kWh
Electricity	380,971 kWh
Total Annual Consumption	1,150,963 kWh

Unit Consumption	461.9 kWh/m^2/year
	42.9 kWh/sq.ft./year



ENERGY MANAGEMENT PROGRAM
ROLLING RIVER SCHOOL DIVISION
ERICKSON COLLEGIATE, ERICKSON

FIGURE 3

4.2 TANNER'S CROSSING

Tanner's Crossing is an elementary school which was built in the early 1970's. The construction is two storey concrete block with face brick. The first floor area is 48,300 sq.ft. (4,487 m^2), and the second 12,100 sq.ft. (1,241 m^2). The 17 classrooms are open plan with high ceilings and minimal glazing. There are fifteen Lennox C151 rooftop units with direct gas fired heat exchangers and DX cooling. The secondary source of heating is a gas fired boiler connected to a reheat coil and a perimeter radiation loop. The building has a gymnasium, library, theatre, and industrial arts and home economics facilities in addition to regular classrooms. The total enrollment, including special education students, is 474 students.

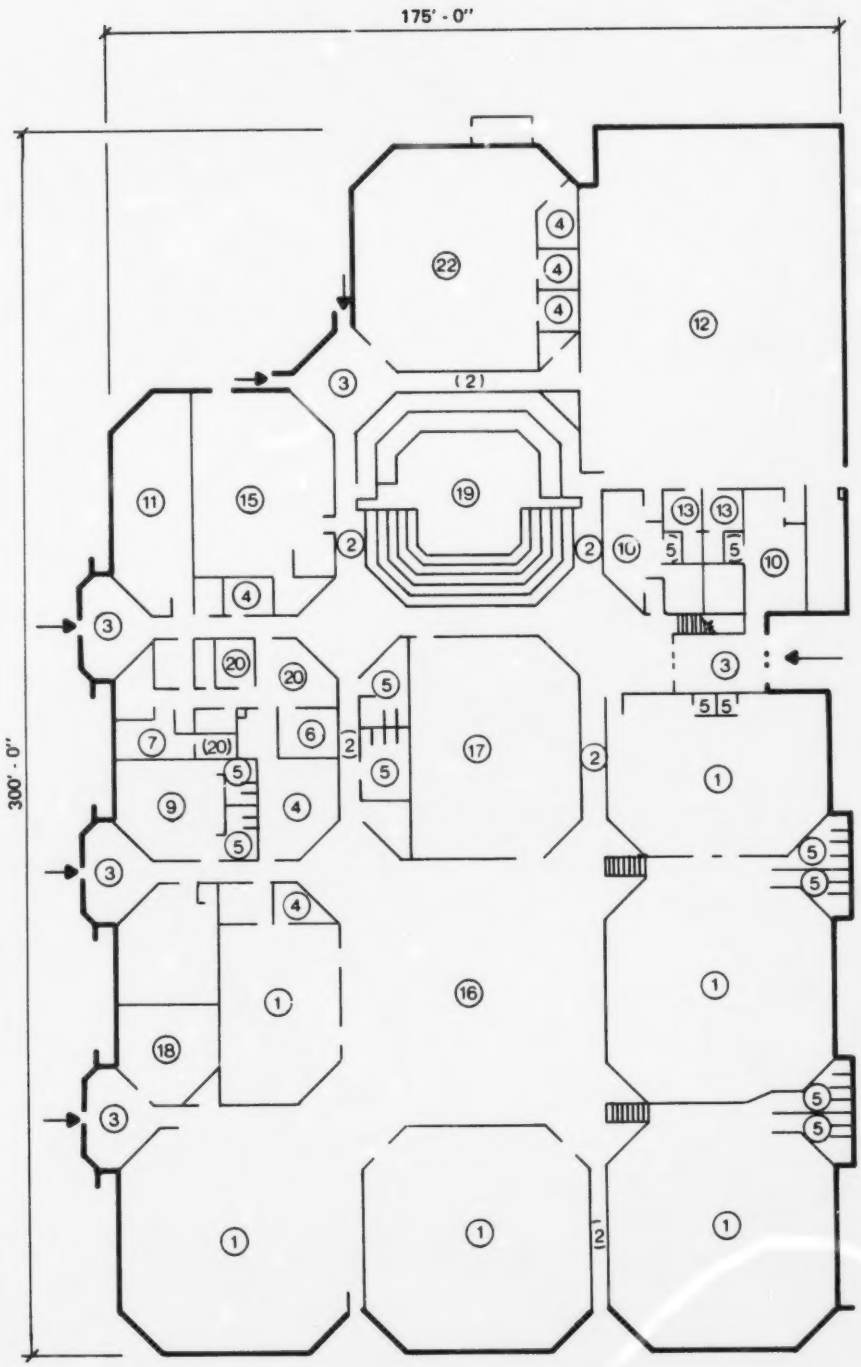
The roof is built up with an insulation value of R8. The power supply is 3 phase 600 volt - 1000 amperes. Load shedding is utilized.

4.2.1 Energy Consumption:

Annual Energy consumption (1981/82) was as follows:

Natural Gas	1,861,409	kWh
Electricity	753,300	kWh
Total Annual Consumption	2,614,709	kWh

Natural Gas Energy Use Index	1.03	MCF/D.D. heating
Unit Consumption	462.6	kWh/m^2/year
	43.0	kWh/sq.ft./year



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. CHANGE ROOM
11. ART ROOM
12. GYMNASIUM
13. INSTRUCTOR
14. SPEECH THERAPIST
15. HOME ECONOMICS
16. LIBRARY
17. COURT YARD
18. DENTAL CLINIC
19. MUSIC, DRAMA, LUNCH
20. OFFICE
21. ELECTRICAL ROOM
22. INDUSTRIAL ARTS
23. COMPUTER ROOM

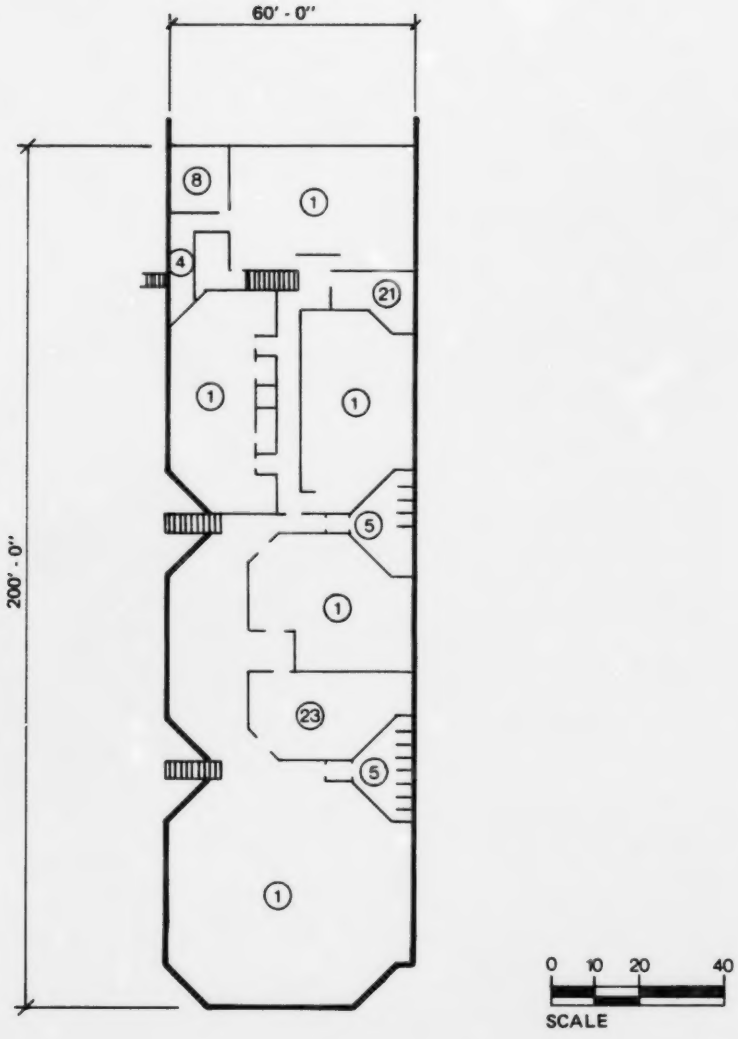
AREA = 60400 ft^2 (5619 m^2)

0 10 20 40

SCALE

ENERGY MANAGEMENT PROGRAM
ROLLING RIVER SCHOOL DIVISION
TANNER'S CROSSING SCHOOL, MINNEDOSA
MAIN FLOOR

FIGURE 4a



ENERGY MANAGEMENT PROGRAM
ROLLING RIVER SCHOOL DIVISION
TANNER'S CROSSING SCHOOL, MINNEDOSA
MEZZANINE

FIGURE 4b

4.3 MINNEDOSA COLLEGIATE INSTITUTE

Minnedosa Collegiate provides Grades 9 - 12 education. The 22,848 sq.ft. (2,122 m^2) single storey building was expanded by 13,362 sq.ft. (1,241 m^2) in 1965, and a further 5,642 sq.ft. (524 m^2) in 1978, to the present size of 41,852 sq.ft. (3,888 m^2). The construction is brick-veneered concrete block with a crawl space. The ten classrooms, three laboratories, cafeteria, gymnasium and library accommodate 240 students.

The roof is retrofitted with 3 inch polyurethane foam to an insulation level of R40.

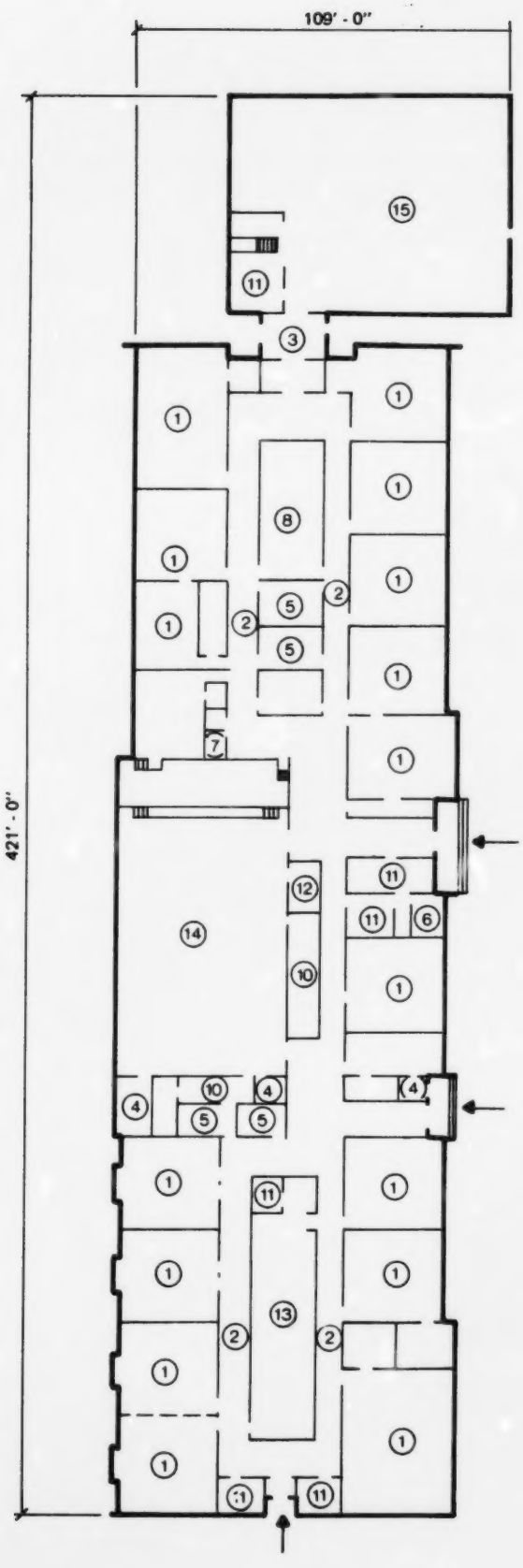
The electrical service is 3 phase 120/208 volts - 800 amperes. Load shedding is not included in the energy control system.

4.3.1 Energy Consumption

Annual energy consumption (1981) was as follows:

Natural Gas	1,478,852 kWh
Electricity	202,720 kWh
Total Annual Consumption	1,681,572 kWh

Natural Gas Energy Use Index	0.80 MCF/D.D. Heating
Unit Consumption	432.3 kWh/m^2/year
	40.2 kWh/sq.ft./year



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. DARK ROOM
8. MECHANICAL ROOM
9. STAFF
10. CHANGE ROOM
11. OFFICE
12. INSTRUCTOR
13. LIBRARY
14. AUDITORIUM
15. SHOPS

AREA = 41852 ft^2 (3888 m^2)

0 10 20 40 60

SCALE

ENERGY MANAGEMENT PROGRAM
ROLLING RIVER SCHOOL DIVISION
MINNEDOSA COLLEGIATE, MINNEDOSA

FIGURE 5

4.4 RIVERS COLLEGIATE

The original 23,668 sq.ft. (2,198 m^2) building was completed in 1961, expanded by 9,881 sq.ft. (909 m^2) in 1963 and a further 3,272 sq.ft. (301 m^2) in 1969. The total area of the single storey concrete block and brick veneer structure is now 36,821 sq.ft. (3,420 m^2). There is a partial basement. The 8 classrooms, 3 laboratories, 2 home economic rooms, library, gymnasium, theatre and industrial art area accommodate 192 students.

The roof is built up with an insulation value of R8.

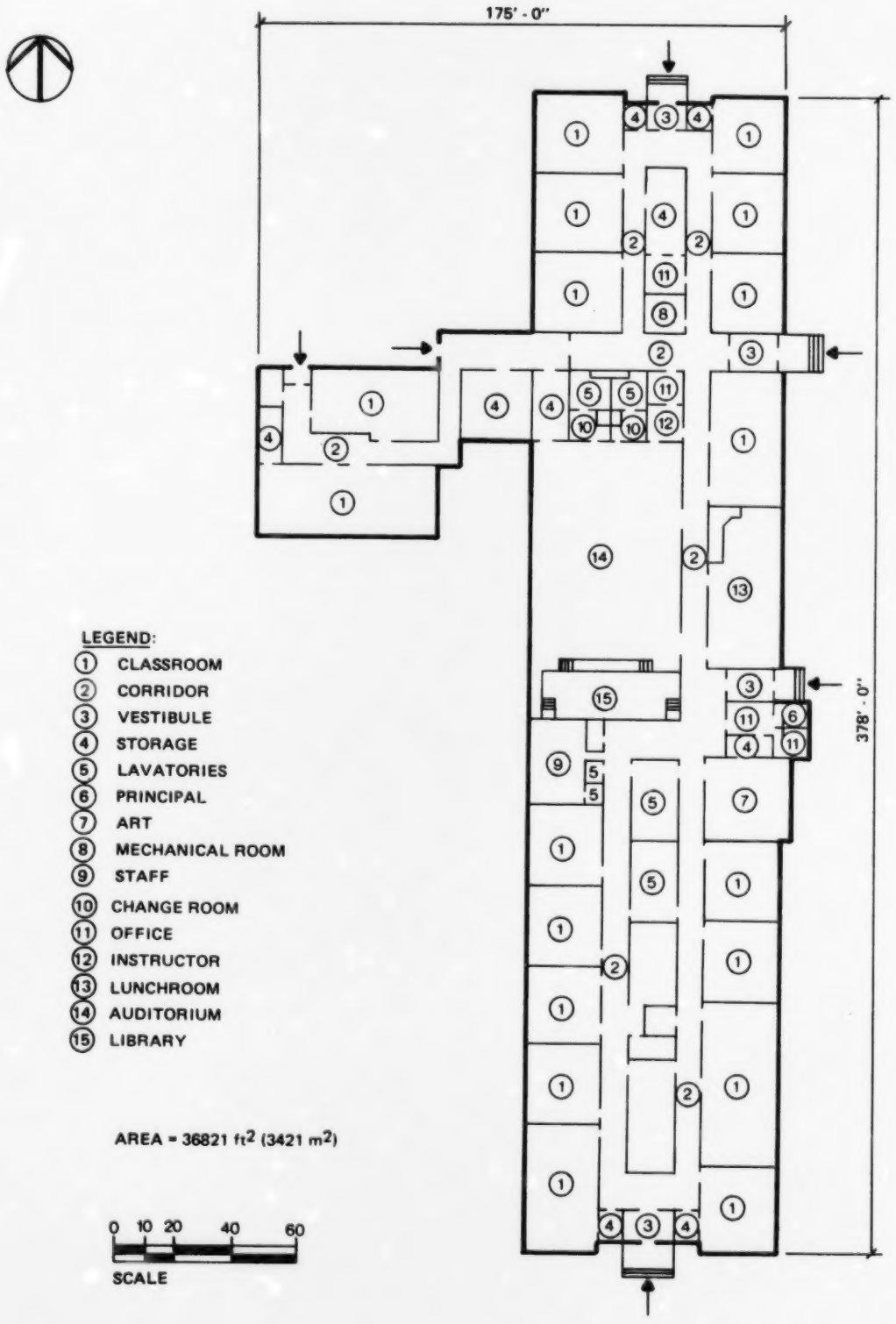
Electrical power is 3 phase 208/110 volts - 400 amperes service. Load shedding is not included in the energy management system.

4.4.1 Energy Consumption

Annual energy consumption (1981) is as follows:

Natural Gas	1,286,256 kWh
Electricity	87,300 kWh
Total Annual Consumption	1,373,556 kWh

Natural Gas Energy Use Index	0.98 MCF/D.D. Heating
Unit Consumption	401.5 kWh/m^2/year
	37.30 kWh/sq.ft./year



ENERGY MANAGEMENT PROGRAM
ROLLING RIVER SCHOOL DIVISION
RIVERS COLLEGIATE, RIVERS

FIGURE 6

5.0 RESULTS AND DISCUSSION

5.1 Energy Savings:

As previously described, Erickson Collegiate was not "on line" during the monitoring period being reported. Also, a building envelope weatherizing retrofit was undertaken at this school in late 1984. The energy consumption for all four buildings will be monitored over the next two years so that those savings due to retrofit at Erickson and those due to the computer system can be differentiated.

A comparison of the 1983/84 school year (with the energy management system) was made with a base year of 1981/82 (before installation of the system). The energy savings calculated for the three schools are listed in Table II and presented graphically in Figure 7.

The goal was to decrease overall energy consumption by at least 35% through the implementation of the energy management system. Table II shows that this level was exceeded, with an average of 40% being achieved for the three schools that were on-line.

Figure 8 presents a comparison of measured monthly natural gas consumption at Tanner's Crossing School for the period October, 1983 to January, 1984, versus monthly degree days. To illustrate the effect of the energy management system, the gas consumption that would be achieved without the system was calculated from historical data (1.03 MCF/D.D.) and also plotted on Figure 8. The average reduction calculated from this projection was 37% for the

four months, which corresponds closely with the total year savings of 39% of heating energy that can be calculated from Table II -

$$\frac{728,517}{1,861,409} \times 100\% = 39\%$$

Historical data has shown that electrical consumption for the buildings is not weather sensitive and therefore a degree day adjustment was not applied to electrical energy.

5.2 Dollar Savings:

A summary of the dollar savings for the three schools on the energy management system is provided in Figure 9. Note that these savings were achieved while the price of natural gas had increased by approximately 25% between 1982 and 1984, and the number of heating Degree Days was approximately 9% higher than the base period.

TABLE II

ROLLING RIVER SCHOOL DIVISION

Consumption Data (kW.h)
(Actual)

SCHOOL	1981/82	1983/84	Savings	Savings
Tanner's Crossing				
Electrical Power	753,300	614,690	138,6106	
Heating	1,861,409	1,132,892*	728,517*	
Total	2,614,709	1,747,582	867,127	$ 14k 33%
Minnedosa Collegiate				
Electrical Power	202,720	155,440	47,280	
Heating	1,478,852	1,032,612*	446,240*	
Total	1,681,572	1,188,052	493,520	$ 8k 29%
Rivers Collegiate				
Electrical Power	87,300	80,740	6,560	
Heating	1,286,256	403,873*	882,383*	
Total	1,373,556	484,613	888,943	$ 18k 65%
Grand Totals	5,669,837	3,420,247	2,249,590	$127k 40%

* adjusted to equivalent degree days (1981/82 base) for comparison purposes. Actual consumption figures were: Tanner's - 1,037,209, Minnedosa - 941,692, and Rivers - 369,762 kW.h.

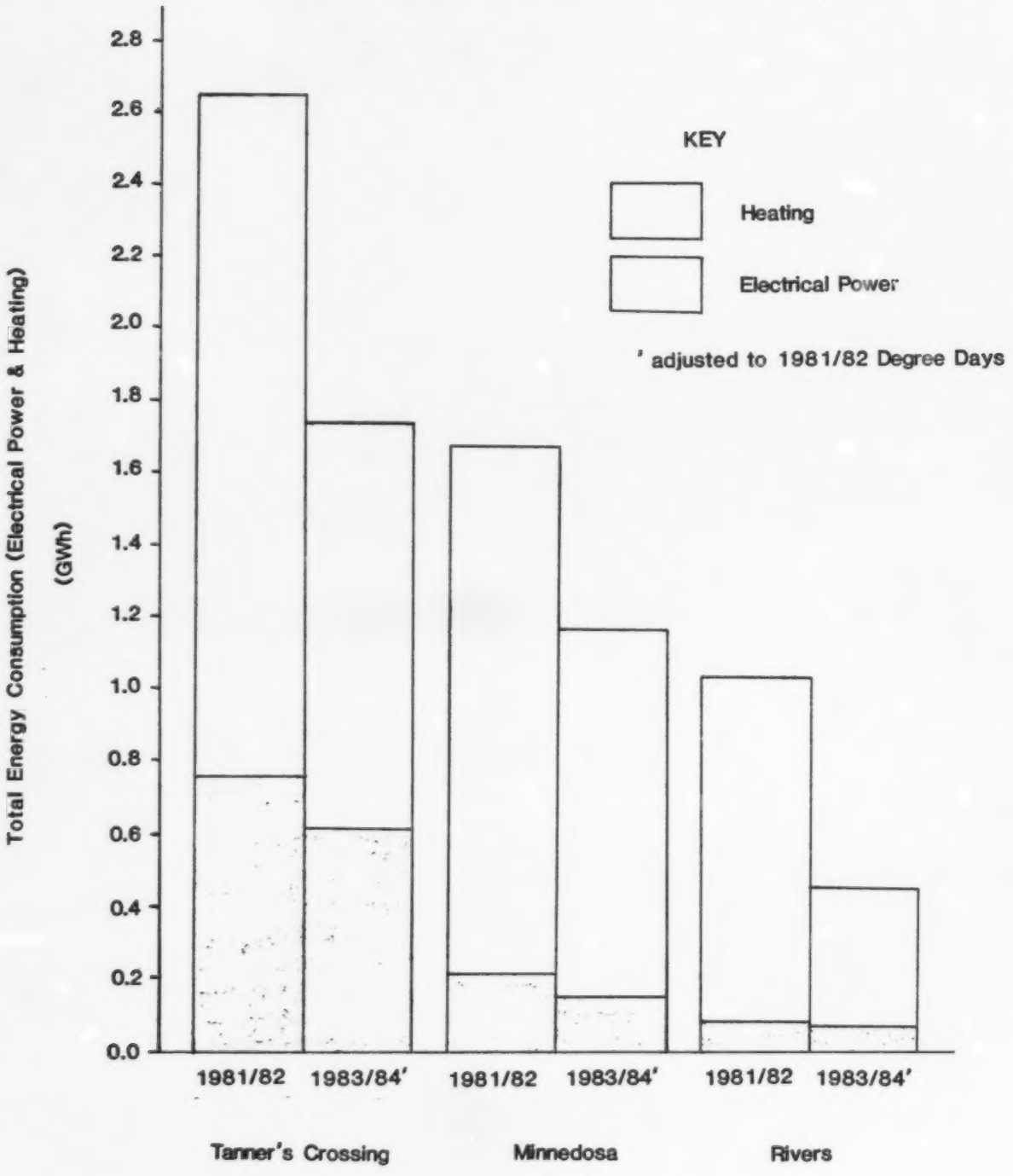
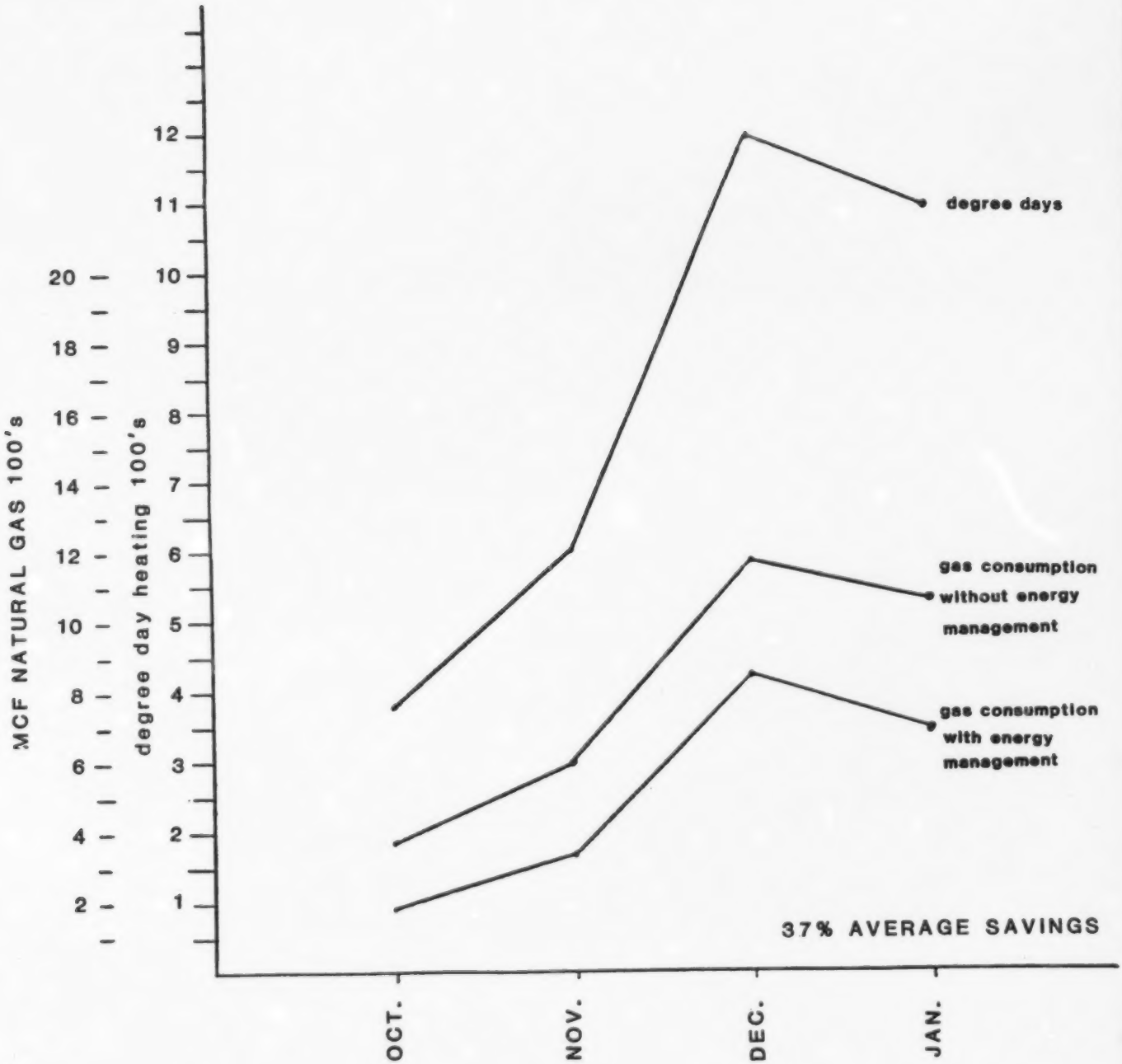


FIGURE 7 ENERGY MANAGEMENT SYSTEM–CONSUMPTION SAVINGS

FIGURE 8

TANNER'S CROSSING SCHOOL

1983/84



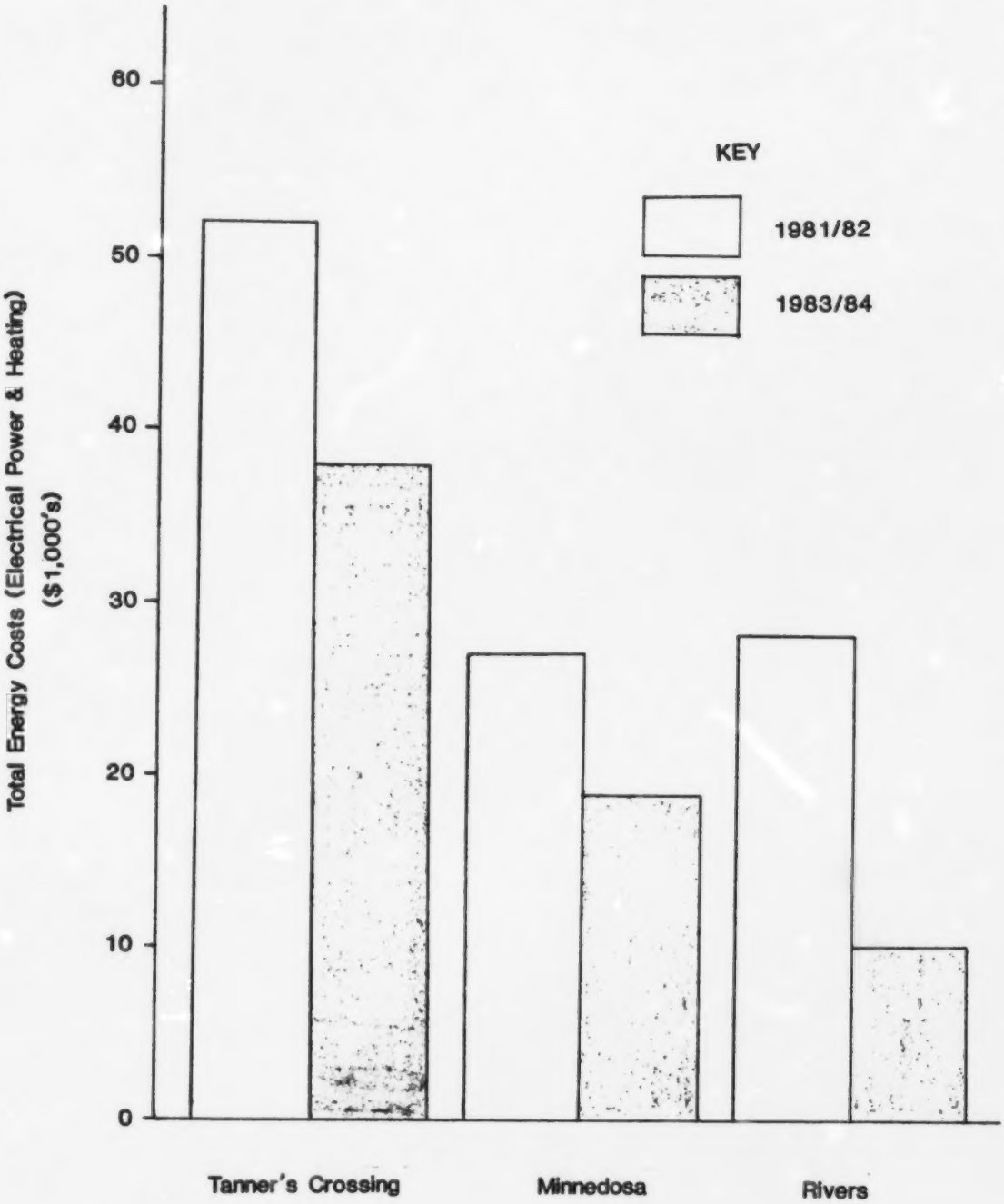


FIGURE 9 MANAGEMENT SYSTEM–DOLLAR SAVINGS

6.0 PROBLEM AREAS

The results for Erickson Collegiate have not been shown due to a problem encountered with communication between this school and the central computer.

This problem developed from "noise" on the telephone line which caused difficulties with data transmission. The problem was encountered in all locations, but was most severe with Erickson. The explanation is that the data was transmitted by hard line from Erickson Collegiate to the local microwave transmitter where it was then converted and transmitted to Brandon. From Brandon it was retransmitted to the Minnedosa receiver and then transferred over hard wire to the computer located at Rolling River School Division #39. By comparison, Rivers Collegiate data was transferred to the local microwave unit with direct transmission to the Minnedosa area receiver and local telephone linkage.

The difficulties with data transmission constitute a major road block using dedicated Manitoba Telephone System lines. Johnson Controls have had a great deal of success with radio transmission of data over a dedicated network so the next logical step is to install this system in Manitoba and test it for a minimum period of one year. The use of a satellite is also a possibility but this is an expensive alternative. However, it could be considered in the future.

7.0 REPLICATION

Based on the initial successful results from Rolling River, two seminars were held and over 200 persons visited the site. School divisions are also eligible under the Community CHEC Program for three schools/division and $15,000/school for a total grant of $45,000/division. Under this scheme, Interlake, St. Boniface and Swan River have established computer energy control systems, and a request has been received from ten school divisions in the Southwest to install a control system with the computer based in Brandon. As well, an energy management system is proposed for a ten-school division in South Eastern Manitoba with the computer located in Winnipeg. The number of schools using this technology will therefore increase from the original four to nearly one hundred if data transmission reliability can be assured. In addition to energy conservation the buildings can be made more secure through the use of central intrusion alarm systems.

8.0 CONCLUSIONS

1. Computer control is an effective energy conservation technique.

2. Annual overall energy savings of up to 40% have been be achieved through the use of computer control techniques.

3. Proliferation of this technique is a sound economic investment.

4. One of the key impediments to this technology is the rapid accurate transmission of data or the use of a dedicated field computer to implement control decisions and then communicate these decisions to a central computer via a Modem linkage.

9.0 RECOMMENDATIONS

1. Computer control technology should be used throughout Manitoba to decrease energy consumption of buildings and assist in maintaining security.

2. A larger scale test should be carried out. If the results confirm economy and reliability of centralized energy management, the technology should be promoted for replication across Manitoba and Canada.

3. The use of alternative means of data transmission, such as radio, should be developed to improve reliability.

3. School divisions particularily should be encouraged at this time to investigate the applicability of computer controlled energy conservation systems to their operations.

APPENDIX

DESCRIPTIVE LITERATURE

JC/85/20
Building Automation System

For today...
And tomorrow

JOHNSON CONTROLS

Designed As The Single Solution

Owners and managers of smaller buildings have long searched for a **single solution** for effectively managing their buildings. In the past, they have been confronted by increasing operating costs that have eroded profits; been victimized by "black box" energy management that provided only partial results; and been offered approaches that ignored the fire and security aspects of building management.

Today, building managers are applying the power of the computer to building management — controlling energy consumption, operating equipment and maintaining comfort and protection. Control strategies designed with the analytic assistance of the computer let managers provide comfort and safety for building occupants while eliminating unnecessary costs.

Until now, computerized building automation had been reserved for large buildings or complexes. Owners and managers of smaller buildings either could not afford an integrated automation system or they paid a premium for a system that was designed for much larger applications.

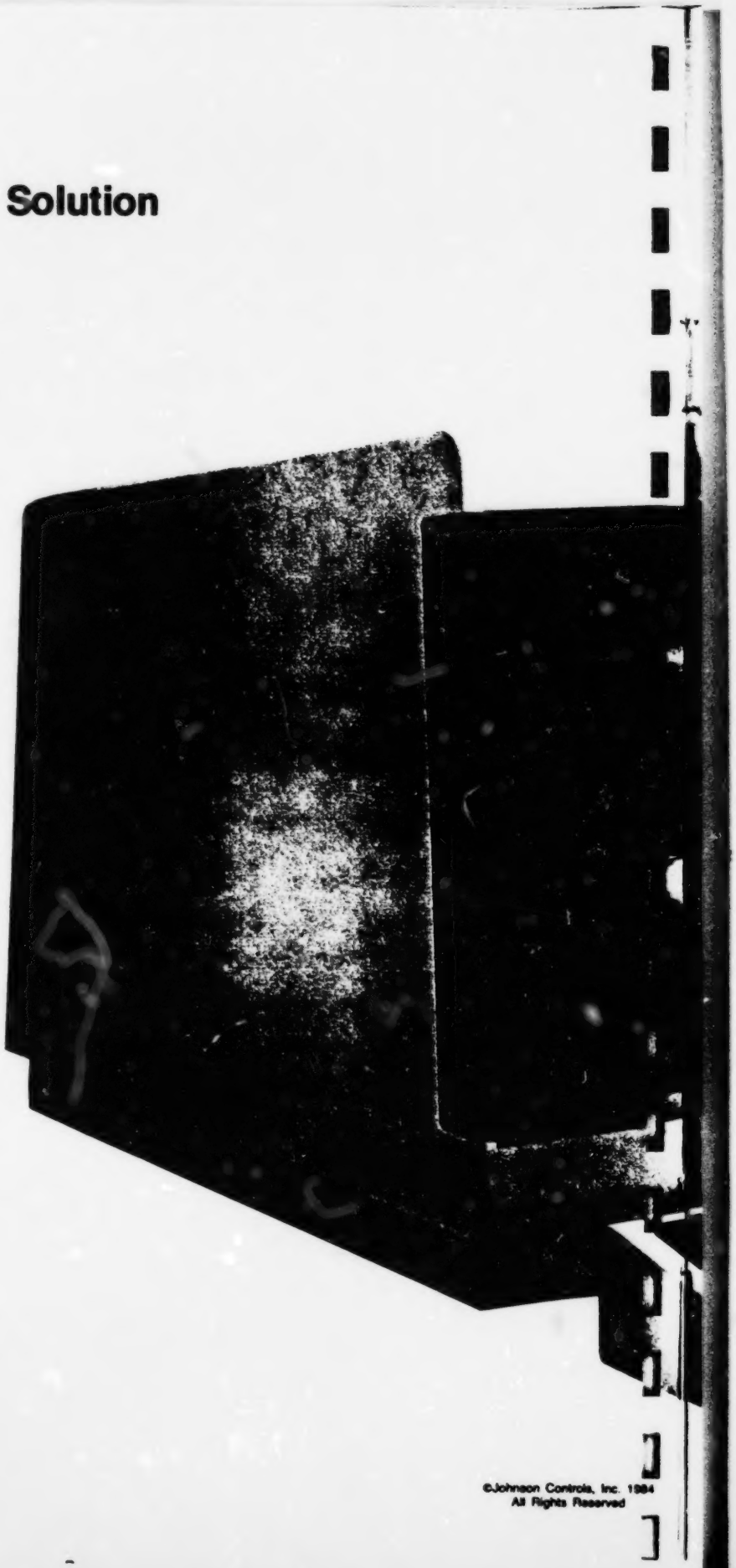
Now there **is** a **single solution** — a cost-effective solution from Johnson Controls.

The Sensible Solution For Smaller Buildings

Johnson Controls has designed a computer-based system especially for smaller buildings, the JC/85/20 — making **complete** building automation a reality for owners and managers of both large and small buildings.

The JC/85/20 Building Automation System is designed for professional managers who know their business but may not be computer experts. It will reduce energy consumption, help make better use of human resources, extend equipment life by helping manage maintenance while it safeguards the building and its occupants. It is designed to minimize operator frustration by managing operations with speed and accuracy in everyday language.

The JC/85/20 will help you select control strategies with imagination and foresight — faster and with more accuracy than ever before. You will be able to pinpoint inefficiencies, anticipate potential breakdowns or emergencies and forecast the effects of increased energy costs, yet maintain occupant comfort and safety. The JC/85/20 is truly the **single solution** for managers who demand predictable control.



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Designed As A Total Building Automation System

The JC/85/20 uses Johnson Controls designed state-of-the-art microcomputer technology to integrate multiple building functions into one, simplified control system. It provides the vital link between all life support and safety systems, including HVAC, fire management and building security — virtually all necessary building monitoring and control functions. Whatever your application, the JC/85/20 lets you establish and maintain your operating strategies with one single system . . . giving you total control of your building.

Complete Energy Management

The JC/85/20 controls and monitors any combination of boilers, fans, chillers, pumps, air handlers, lights and other building equipment to reduce energy consumption. It scans remote corners of the building through a network of sensors to detect problems that can escape manual methods. It will also help you develop strategies for increasing efficiency by providing valuable management reports that let you compare and analyze current and past operating procedures on actual energy use.

Programs such as Demand Limiting and Duty Cycling stabilize and minimize electrical energy consumption. Other programs provide savings through delayed equipment start-up and automatic set-point adjustment. And if one of the standard programs does not exactly fill your needs, the JC/85/20 User Programming Language can be used to define your programs on-line. You gain total energy control from centralized locations. But you don't have to be content with just total energy control.

Reliable Fire Management

The JC/85/20 integrates fire management with energy control capabilities. Fire management helps contain a fire in its earliest stages, minimizes damage, and provides clear, understandable directions to people in the fire area. The system accurately and concisely directs the critical responses of your building's control center staff. With precise, reliable programming, emergency strategies are predetermined, long before the need arises. Should the fire situation change, the staff can assist fire fighters by assuming full control through the computer console.

Added Security

With the JC/85/20, all security components report through one control center. They all report in the same format and language. Printers, monitors and alarms are all coordinated. The information received is clear, permitting fast response time. In most cases, one person can monitor all activity, activate necessary controls, effectively initiate a response to any violation of security and keep management and other security personnel apprised of all activities.

The JC/85/20 can provide additional security from your existing components. Each component, when interfaced with the others, provides an additional overlay of backup protection. For example, CCTV can be integrated with, and automatically activated by, any or all intrusion detection devices.

Cost-Effective Integration

JC/85/20 total system integration will help you fine tune your building to its optimum operating efficiency. While reduced energy costs will pay for the JC/85/20, you'll gain additional savings in initial installation, in ongoing operation and maintenance, in lower insurance rates and in lower tenant turnover in a fire-and-theft-resistant building.

Automated system integration is one sure way to have cost-effective building operation.

Designed To Be "Used"... With Today's Features

The JC/85/20 helps pay for itself through its overall ease of operation. You don't need computer knowledge to understand and operate the system. Therefore, instead of collecting dust through lack of complete use, your JC/85/20 will collect additional savings by prompting creative use of all its capabilities.

Talks Your Language

Simple English language is used for all inputs and system outputs, so you are never confused by a need to communicate in complex technical jargon. It isn't necessary to interpret codes or the language of the computer.

Prompting For Ease Of Operation

Not only does the JC/85/20 speak your language, it tells you how to program and use your system with a step-by-step prompting program. This simplifies operation and makes the JC/85/20 something more than a system with great energy savings potential. It's a system that will be used.

Keeps You Informed

Operators can specify ready-to-use summary data printouts that keep you on top of your building's operations. They give you concise records of past and projected energy consumption so that you can conduct a periodic analysis of your building systems performance. Printouts are available on a scheduled time-of-day basis or by request.

Passwords For System Integrity

The system is safeguarded against accidental or intentional tampering by the assignment of passwords to approved operators. Each password allows the operator access only to information pertinent to that individual's defined areas of responsibility.

Complete Software Library

Johnson Controls provides all the software you need, from basic point monitoring and start/stop control to complex demand limiting and duty cycling load control. Sophisticated fire management including signaling, smoke control and pressurization is available with the JC/85/20, as are security management application programs.

An affordable microprocessor-based system that's specifically designed with smaller buildings in mind.

Total building automation capabilities: energy management, fire management and security.

The latest in state-of-the-art design that's custom tailored to meet your building's specific needs.

Ease of operation through the use of everyday language and logical, step-by-step system prompting.

A variety of field processing units mated to a system created specifically for building automation.

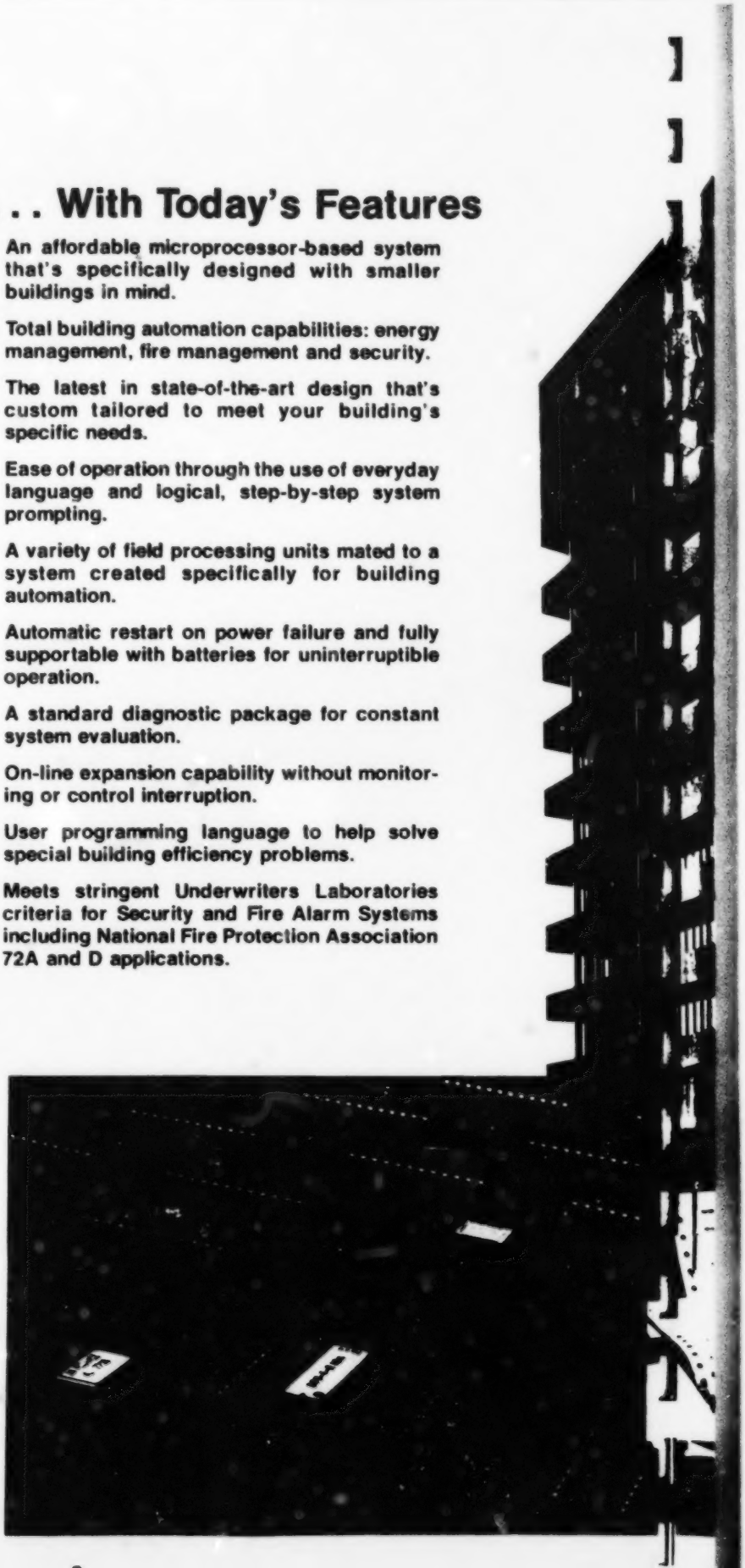
Automatic restart on power failure and fully supportable with batteries for uninterruptible operation.

A standard diagnostic package for constant system evaluation.

On-line expansion capability without monitoring or control interruption.

User programming language to help solve special building efficiency problems.

Meets stringent Underwriters Laboratories criteria for Security and Fire Alarm Systems including National Fire Protection Association 72A and D applications.



Designed To Expand With Your Needs

At Johnson Controls we know that each building has its individual characteristics. Needs differ and they change frequently. That's the beauty of the JC/85/20. It's a full-fledged building automation system that's specifically tailored to your building and is flexible enough to adapt to its ever-changing needs. Whether you have an old building, a relatively new building or are planning to build one, the JC/85/20 is the right choice. Now and in the future. It's truly a system for today and tomorrow.

A JC/85/20 can start small and be expanded according to your needs. For example, a system installed for basic HVAC control and energy management can be expanded to include Fire and/or Security functions. A system that originally controls a single building can also be upgraded to handle multiple buildings. Remote terminals can be added to allow key personnel to monitor or control their operations or buildings.

The JC/85/20 uses all standard JC/85 field hardware. Its shielded twisted pair, multi-drop trunk communication scheme simplifies field wiring and allows expansion in virtually any direction.

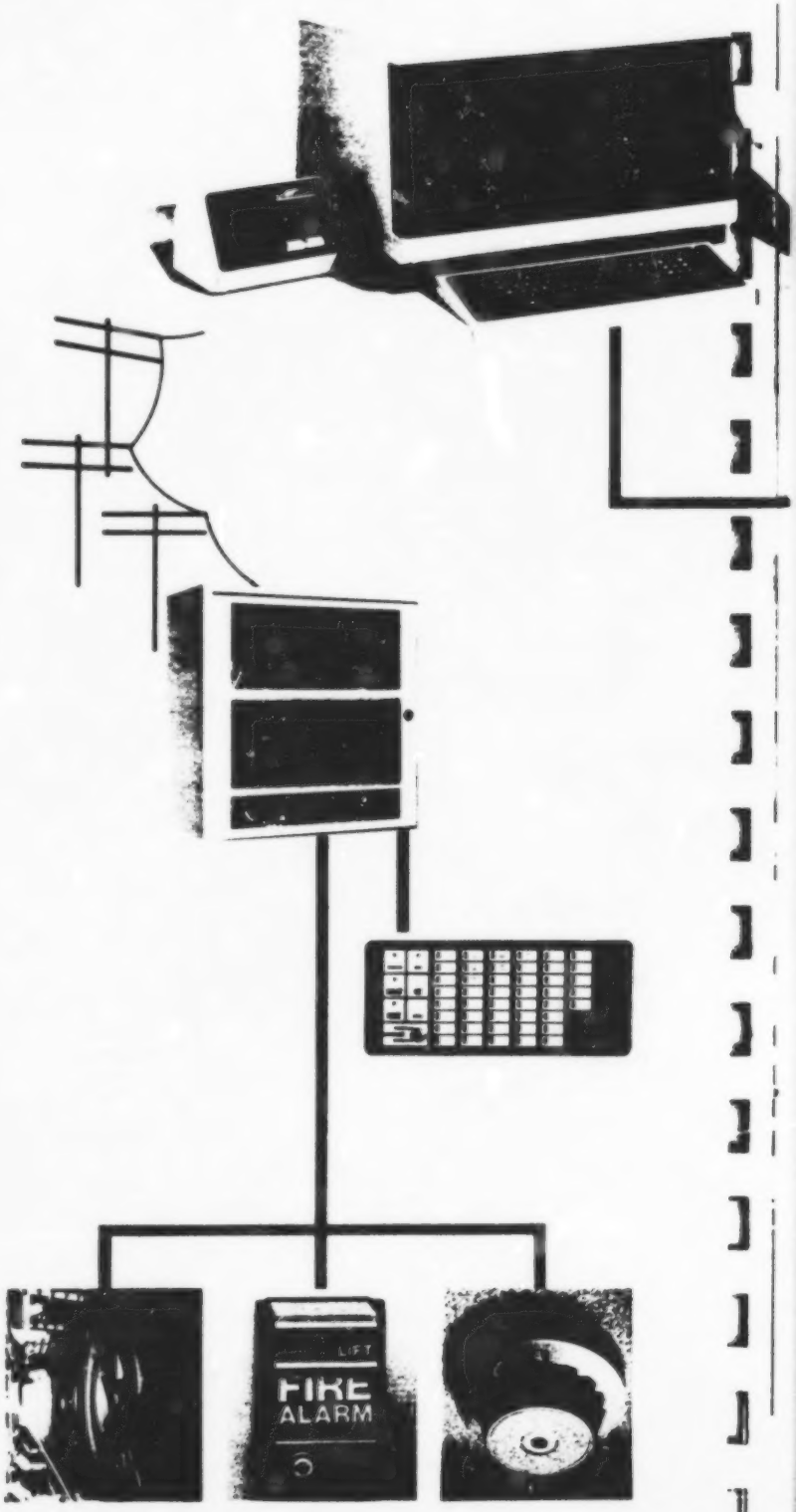
Modularity Makes It Your System

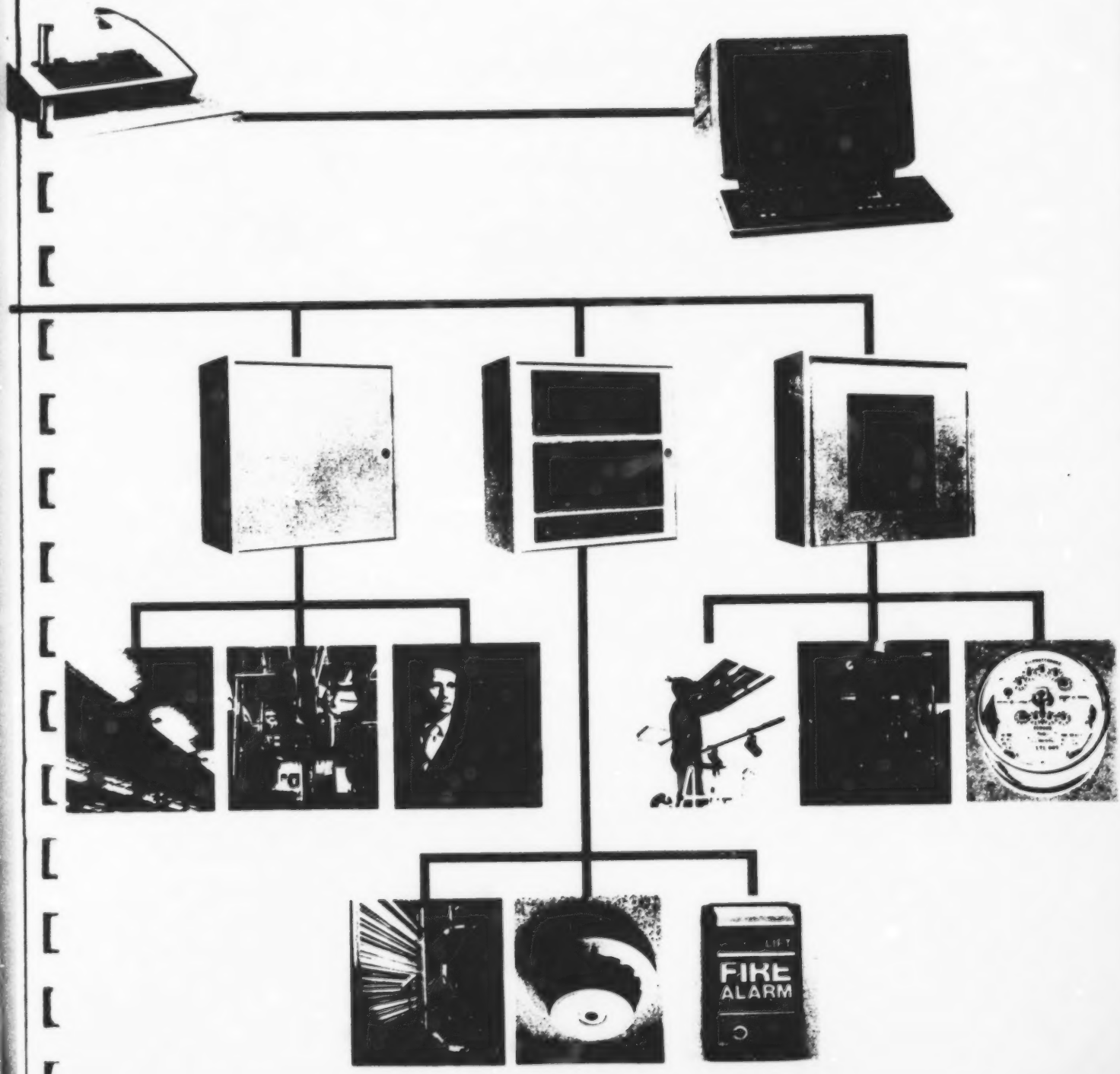
The JC/85/20 provides a new dimension in modular hardware for building automation. The precise combination of these system elements is chosen according to your needs. You control your building with a system that is based on your specific requirements. No more, no less.

Regardless of the choice of hardware and field or trunk wiring, the JC/85/20 CPU constantly monitors the communication quality of the trunks and issues advisories to alert the operator of any hardware malfunctions.

The JC/85/20 has also been engineered to be compatible with any Johnson Controls hardware, including our DSC-8500 Digital System Controller which is designed to handle difficult applications requiring direct digital control techniques and stand-alone intelligence.

Flexible. Expandable. Reliable. The JC/85/20 is a Building Automation System this is designed to grow as you do. It is the **single system solution** for managing energy, comfort and protection.




FIRE
ALARM

The Company That Helps You Manage Energy, Comfort & Protection

For a century, Johnson Controls has emphasized single-source responsibility in the design, installation and service of building control systems. Our broad range of system capabilities gives you total control of energy management, fire management and security, with systems tailored to every budget and every size building or complex.

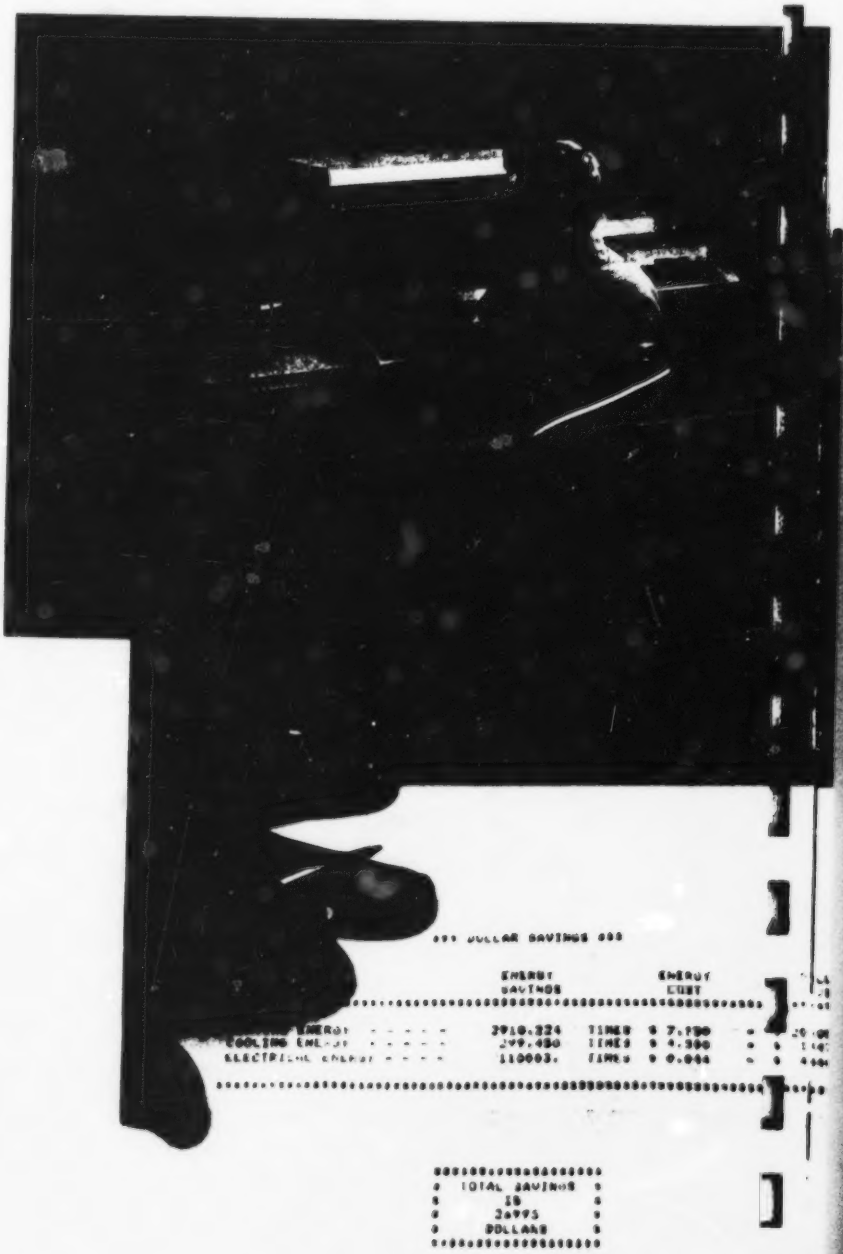
Our unique approach to satisfying the specific needs of our customers even includes EFACT — a service designed to determine potential energy savings based on local weather and actual building data. It tells you what features are most cost-effective and also those which cannot be justified. It evaluates whether you should purchase the system or utilize financial services to lease the equipment.

Our engineers, technicians and installers will present you with a complete, functional system that will meet your requirements. Once it's in place and operational, you won't be left with an instruction booklet and a handshake. We train your personnel to understand and operate the system.

We are also prepared to maintain the system beyond the warranty period. A Johnson Controls maintenance contract includes regularly scheduled preventive maintenance, replacement or repair of worn parts as needed, and round-the-clock emergency service if the need arises. And we'll do it all at a preset contract rate that you'll know about in advance.

Each one of our worldwide offices combines local sales and application professionals, regional and national support, proven automation system hardware and software, reliable installation and commissioning, custom programmed maintenance, and training to help you operate your building efficiently. That's Johnson Controls — managing energy, comfort and protection.

One source. One reliable name — Johnson Controls. Whether you're starting fresh, adding on, modifying or updating, give us a call. A Johnson Controls sales engineer in your area will show you how to make your building work better for less.



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